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THE IMPORTANCE OF OBSERVING METEORS.[1]

By F. R. Moulton.

No other branch of practical astronomy offers so great an opportunity for interesting and scientifically important work, to one possessing only a meager or no instrumental equipment, as that of observing meteors. In fact, most of the work in this line can be done entirely without instruments, and those who are under obligations to employ powerful telescopes for the purposes for which they are designed cannot even undertake it. The purpose of this article is to point out the things (most of which are of course well known) which observations of the meteors may teach us. They will be mentioned in the order of simplicity of making the observations.

1. The simplest thing to do is to record the number of meteors which can be seen during a given interval of time. This is obviously done without any instrumental help, and in order to get enough data to be of any particular value an enormous amount of time is required. To make such observations of the greatest value, the date on which they are made and the precise part of the day should be recorded, and a part of the sky of definite size and location should be watched. Such observations can be expected to give the variation in the number of meteors visible at the different parts of the year and of the day, and in various parts of the sky. These are obviously questions of the first importance in determining their distribution in space. For example, astronomers wish to know whether all meteors are the remains of disintegrated comets, or whether most of them circulate around the Sun like infinitesimal planets, or whether many may not be wanderers in interstellar space and thick enough to cut off appreciably the light of distant stars. This last question is one of importance in connection with that of the extent of the

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[1] Reprinted from *Mon. Reg. Soc. Prac. Astron.*, March, 1915.

The general policy of the Publication Committee is not to reprint articles which have been published elsewhere and which are readily accessible to our readers. We make an exception in the present instance because we wish to emphasize the fact that, however many powerful telescopes may be in use, there is still a great deal of valuable practical astronomical work that can be done, and, indeed, *must* be done with "meager or no instrumental equipment." Publication Committee.

sidereal system, and is now a very live subject, as the readers of KAPTEYN'S papers know.

In addition to simple counts of meteors, it is easy to record their color, their apparent speed, and their brightness as compared with the stars.

2. Everyone is familiar with the fact that many meteors belong to "streams," that is, they move in parallel paths across the orbit of the Earth. In order to establish a meteor stream, or to contribute to the proof of the existence of a meteor stream, the apparent paths of the meteors must be recorded. This can be done only on star maps[1] prepared in advance. There is abundant opportunity for the exercise of skill in making these observations. The degree of accuracy of the work can be checked by two or more observers working together, at least occasionally. Work of this kind has been industriously carried out by English observers, who have less favorable climatic conditions than prevail in most parts of the United States.

3. The height of meteors can be determined from simultaneous observations by two observers a few miles apart. Observations have shown that meteors usually become visible at a height of sixty to ninety miles above the Earth's surface. Hence the distance between the observers may be anywhere from five to fifteen miles. In order to be sure that both observers have seen the same meteor, the exact time and other circumstances of its appearance should be carefully recorded.

4. Now and then bright meteors leave luminous trains which are visible from a few seconds up to many minutes. *The motions of these trains should always be very carefully observed and their positions with respect to the stars recorded as accurately as possible from time to time as long as they are visible.* Such observations will give us information regarding the movements of the upper atmosphere at a height which can be reached in no other known way. Meteorologists are eager for any information in this line which can be obtained. It is clear that it is especially valuable when the meteor is observed by two observers a few miles apart so that its altitude can be determined with considerable certainty.

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[1] See *Publ. A. S. P.*, **28**, 101, 1915.

5. For some purposes it is important to know with what speed meteors move when they enter the Earth's atmosphere. If a meteor is observed by two persons a few miles apart the length of its path can be computed. Hence, in order to get its speed, it is necessary only to know how long was required for it to describe its path. This can be estimated with some approximation by experienced observers. A much more accurate way, which at the same time gives the position of the meteor accurately, is to photograph the sky with a camera following the stars and having in front of its objective a rotating screen which alternately admits and cuts off the light. The star images will be definite points and the meteor trail instead of being a continuous line will be a series of dashes corresponding to the times when the screen was edgewise to the camera objective. The photographs from the two places will locate the meteor, and, if the rate of rotation of the screen is known, its speed can be computed.

6. Finally, if in addition to the data of (5) the brightness of the meteor is determined, its mass can be computed. For, when a meteor strikes the atmosphere its energy of motion is largely changed to light, and the brightness of a meteor at a known distance and of a known duration furnishes the amount of radiant energy it emits. The brightness can be determined, of course, by comparing its trail with the star images, taking into account the length of the exposure. Now the energy of motion of the meteor, which is changed into a measured quantity of light energy, is proportional to the product of the mass and the square of the speed, which can be computed from the observations of (5). Hence the mass can be computed. Then, with the data of (1) it is possible to compute how fast the Earth is growing by the accretion of meteoric matter.

This will serve to show the great importance of observing meteors, and professional astronomers will welcome all additions to observers who follow these objects.

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